

FILE COPY
NO. 6

AIRCRAFT CIRCULARS
NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

No. 154
(Supplement)

SUPPLEMENT TO
THE SUPERMARINE S.6.B. RACING SEAPLANE (BRITISH)
A Low-Wing Twin-Float Monoplane

FILE COPY

To be returned to
the files of the National
Advisory Committee
for Aeronautics
Washington, D. C.

Washington
February, 1932

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

AIRCRAFT CIRCULAR NO. 164 (SUPPLEMENT)

SUPPLEMENT TO

THE SUPERMARINE S.6.B. RACING SEAPLANE (BRITISH)

A Low-Wing Twin-Float Monoplane

HOW THE SUPERMARINE S.6.B. WAS BUILT*

Through the courtesy of Mr. R. J. Mitchell at the Supermarine Aviation Works, Ltd., we are able to give a general description of the internal structure of this seaplane and publish some pictures which will serve to give the world an idea of the way in which the Supermarine Works produced the fastest airplane in the world.

Everybody is familiar with the general layout of the seaplane as a low-wing wire-braced twin-float monoplane with a cantilever tail unit.

The Wings

The wings are of conventional two-spar construction with ribs spaced at $9\frac{1}{2}$ -in. centers. The entire surfaces, with the exception of the ailerons and rounded wing tips, are covered with radiators, which are screwed directly to the ribs and form the flying surfaces. (Fig. 1.)

The spars are built-up boxes of duralumin with channel-section webs which have outwardly-turned flanges. To these the flat strips which form the flanges of the spars are riveted. Each of the webs has a single longitudinal corrugation and this is flattened out at the points of attachment for fittings. The way this is done is interesting.

The superfluous amount of metal is removed by drilling two holes on the neutral axis and cutting slots of the proper width from one to the other. When the flanges have been flattened out this gap closes up. The material used is mainly 14 G. duralumin, but at points of localized stress in the way of fittings and the like the proper

*From The Aeroplane, December 16, 1931.

number of doubling plates are attached.

The reason for the angle at which the rear spar is inclined is that the stub spar is built into the fire-proof bulkhead, which has to be so slanted as to give adequate room at the rear of the engine.

The ribs consist of 16 G. duralumin diaphragms with flanged lightening holes. To the diaphragms are riveted flanges of extruded angle-section. The legs of the angle are of unequal thickness, one is $1/16$ in. and the other $3/16$. The latter is drilled and tapped to take the screws which hold the wing radiators in position.

The ribs are made in sections, as their flanges have to be flush with those of the spars. They are attached to these through vertical angle-pieces riveted to the webs of the spars before these are finally assembled. That is characteristic of these seaplanes, a kind of jig saw puzzle progress.

The inlet and outlet channels of the radiators necessitate the leaving of slots in the ribs, and this is achieved by dividing the diaphragm and joining the sections with small channel pieces. A similar arrangement is used at the nose, where a 10 G. strip is carried by such channels and to it is screwed the leading edges of the upper and lower radiators. These joints are finally covered with a capping strip attached in a similar fashion.

The wing-root fittings are attached to lugs on the stub spars by horizontal bolts and nuts. These fittings are of steel.

Each aileron moves between two shielding plates that form continuations of the upper and lower wing surfaces respectively and is operated by a push-pull rod that passes through the spar to an ordinary sort of bell crank.

The Wing Radiators

The wing radiators are built up from sheets of 24 G. duralumin arranged in pairs. The seams are made by riveting the sheets together with strips of Langite $1/16$ thick between them. The sides of the radiator are $1/8$ in. apart and this distance is limited by the means used to space the sheets apart. (Fig. 2.)

The radiators are attached to the wing structure by screws which pass through eyelets in the radiators and then pick up tapped holes or bosses in the wing beneath. When the radiator sheets have been drilled to take the eyelets they are separated and each hole is flanged with a special punch. When the sheets are put together again with the flanges facing inwards, the flanges butt up against each other and the eyelets when squeezed down make the whole joint water-tight. There is however, a certain relation between the gauge of sheet and the depth of flange, which can be made without cracking when the eyelet is pressed home. This relation limits the spacing of the sheets to $1/8$ in.

The radiators are made with seams running fore and aft (parallel to the ribs), and these seams act as baffles so that the water has to flow across the wing and cannot pass diagonally from its point of entry to the collector pipe along the trailing edge.

The heaviest of the bracing wires is the front landing wire, which is of $5/8$ in. diameter, the others vary according to the duties imposed upon them.

The Fuselage

The fuselage is a monocoque structure with 46 frames, or rather "stations," more or less equally spaced some 6 in. or 7 in. apart. (Fig. 3.) These are covered with duralumin sheeting. (Fig. 4.) One mentions this as it helps to give one some idea of the size of the engine bearers, which run from the nose back to frame 40 and form the only longitudinal members of the structure. The frames are mainly built from 18 G. strip and are of "U" section with two outwardly turning flanges, to which the skin plating is fixed.

The engine bearers are of 14 G. duralumin, though necessarily strengthened by doubling plates at points of localized stress. Each bearer is of right-angle section, with the flanges bent back and shaped to fit the sides of the fuselage. The top flange of the angle is naturally kept for the engine feet to rest upon.

One might mention in this connection that whereas the fore-feet are bolted hard down, the rear feet rest in rubber pads and the holding bolts pass through slots in the bearers so that the engine can stretch itself as it warms up.

Between the engine and the cockpit is the sloping fireproof bulkhead with the water-header tank built into the top of the fuselage immediately behind it. The bulkhead is a sandwich of asbestos between the bulkhead proper and a sheet of duralumin fastened thereto. In spite of the numerous passages for pipes and controls which pass through it as well as a large inspection door, this bulkhead does keep a lot of heat away from the pilot.

The Fin and Oil Tank

At the tail the structure merges into the fin, which, together with most of the fairing behind the pilot's head, forms the oil tank and cooler. (Fig. 5.) This part of the structure has naturally to be oil-tight and is therefore built of tinned steel. The curious criss-cross of riveting which shows up so clearly in photographs of the tail-unit is due to a large number of sloping gutters along the sides of the fin, so disposed that the oil, after being sprayed from the pipe at the top of the fin, is made to trickle down the gutters and over the internal structure, thereby ensuring that the greatest possible amount of oil is in contact with the metal all the time.

A similar purpose is served by the oil-coolers along the sides and belly of the fuselage. Those along the sides take the oil to the fin and that along the belly returns it to the engine. These coolers are shallow channels of tinned steel attached to the side of the fuselage.

They owe much of their efficiency to a number of tongues of copper foil athwart the flow of oil. These are soldered to the sides of the cooler and project at right angles into the stream of oil. They are staggered in such a way that the flow of the oil is not too seriously impeded. (Fig. 6.)

Control Surfaces

The rudder is built like the ailerons and is operated by cables attached to a lever inside the tail fairing and carried by an extension shaft bolted to the rudder spar. Into the rudder is built the trailing-edge strip of duralumin, which proved so useful for adjusting trim at full speed.

The stabilizer spars are built into the fuselage structure with ribs of conventional pattern. The whole has a

riveted-on skin of light gauge duralumin sheets.

The elevators are built like the ailerons and are operated by a lever inside the fuselage. The elevator spars are formed by closing a channel with a leading-edge member of circular section.

An interesting feature of design is that the elevators are made to fit the fuselage as closely as possible. The ordinary cutaway used to clear the rudder movements results in an extremely poor streamline section at that part of the elevator. In the S.G.B. this was avoided by ending the bottom of the rudder above the top limit of the elevators' travel.

The Floats

The floats have a mean reserve buoyancy of 57 per cent and are carried by four T.1 steel tubes. They are all 2 in. outside diameter, but the front pair are 8 G. and the after pair 17 G. (Fig. 7.) At the top sockets of conventional pattern are used to hinge these to lugs on the fuselage. The front pair of struts also serve to support the engine mounting, to which they are attached.

At the lower end the tubes are built rigidly into the floats and pass through duralumin blocks through which they are bolted to the double frames. Where the tubes leave the floats they are naturally subject to very heavy loads in bending, so the tubes are stiffened against these stresses with a number of tongued sleeves.

In general conception the floats are conventional, though complicated to an inordinate degree by the fact that their middle portions are fuel tanks and their decking is formed by water radiators.

The fuel tanks were built to a full cross section of each float and have duralumin internal members with a tinned steel skin. Where the internal frames come in contact with the skin tinned-steel angle pieces have to be used so that the rivets can be sweated over to ensure watertightness.

The rest of the float is built up conventionally with transverse frames stiffened by longitudinals. The bottom plating is mostly 16 or 18 G. duralumin.

This year for the first time water radiators were used to cover the entire floats above the chine line. These are built in the same way as those on the wing, but are in five sections to each float. This necessitates an intricate system of connections which are reached through handholes. (Fig. 8.)

These floats are a remarkable example of what can be done in the shops. The radiators could not be built to the floats, as both had to be made at the same time, so the former had to be built to molds. In spite of this, when the radiators were finally in position holes in the radiators picked up tapped bosses which had been sweated to the inside of the fuel tanks.

Anyone who has anything to do with building floats will realize at once the difficulties of working to limits demanded by such methods of assembly.

This brief account of the general structure of the Supermarine S.6.B. does not attempt to describe in detail the actual manufacturing difficulties which must be overcome in building a racing craft of this type. It may, however, serve to show how Mr. Mitchell adapted the ordinary practice of aircraft engineering to produce the fastest seaplane in the world.

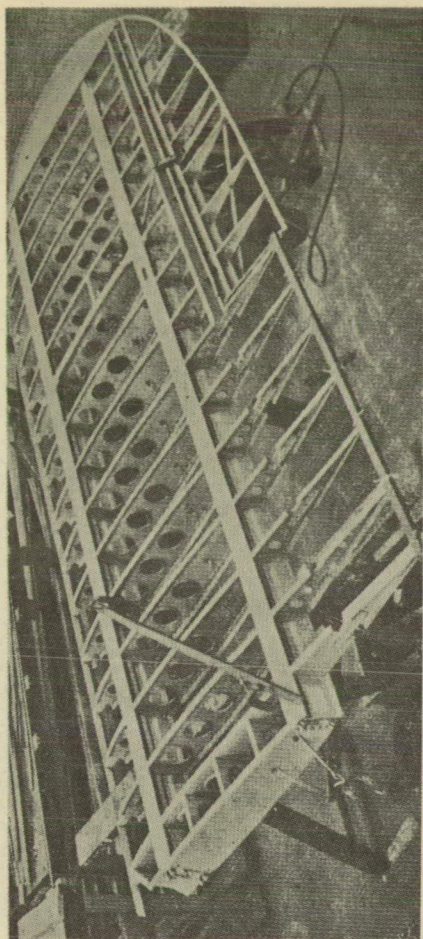


Fig. 1 The skeleton of the starboard wing.

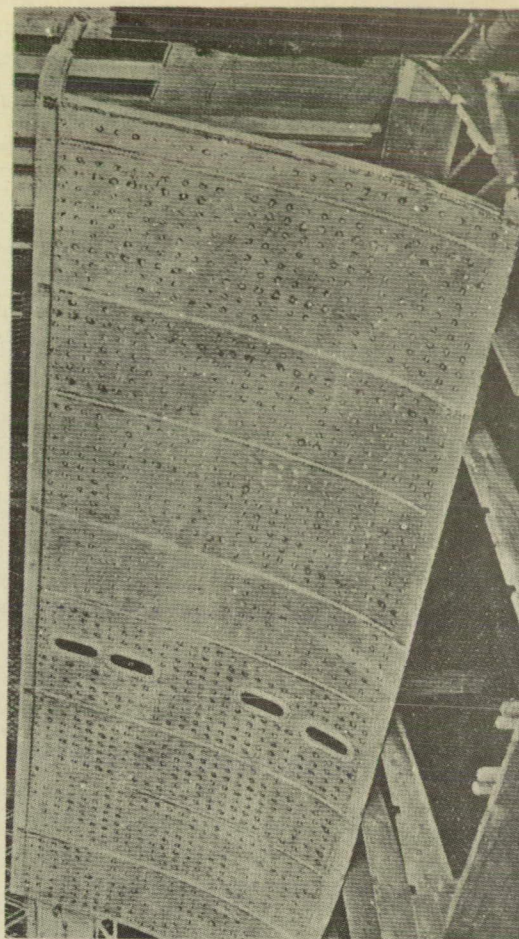


Fig. 2 The upper surface water radiator for the port wing ready to be placed in position.

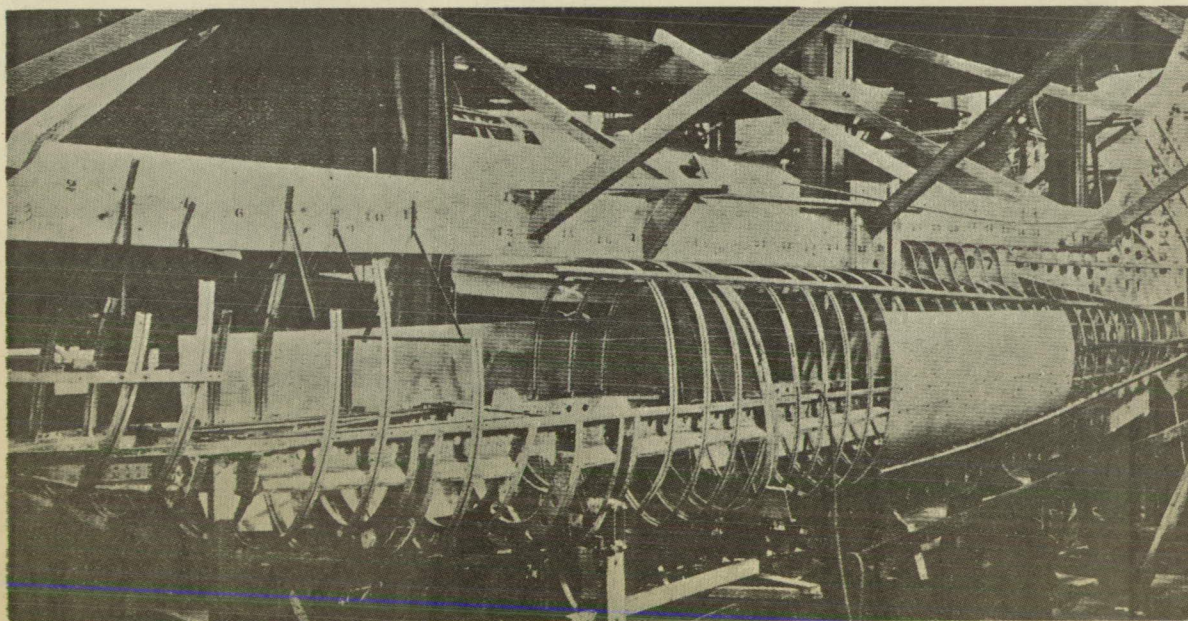


Fig. 3 The skeleton of the fuselage of the S.6.B. on the stocks.

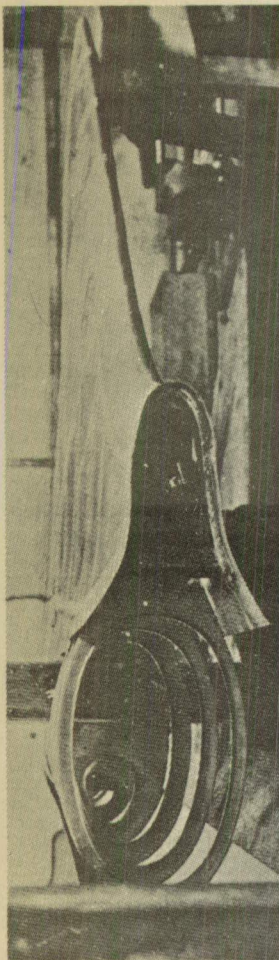


Fig. 5
The fin
oil-tank.

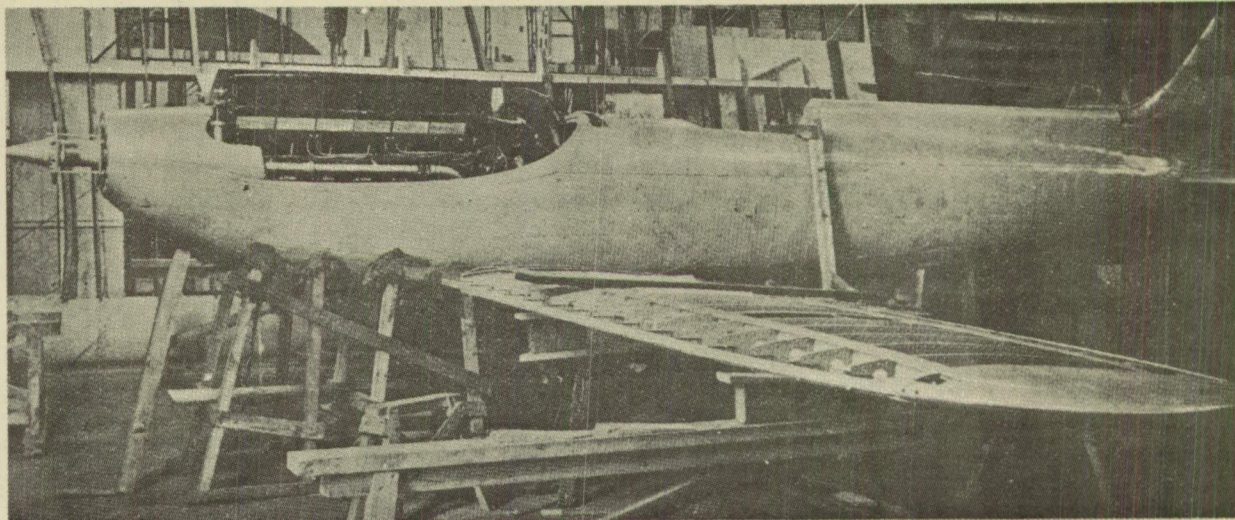


Fig. 4 The fuselage complete with covering and with the Rolls-Royce "R" engine in place.

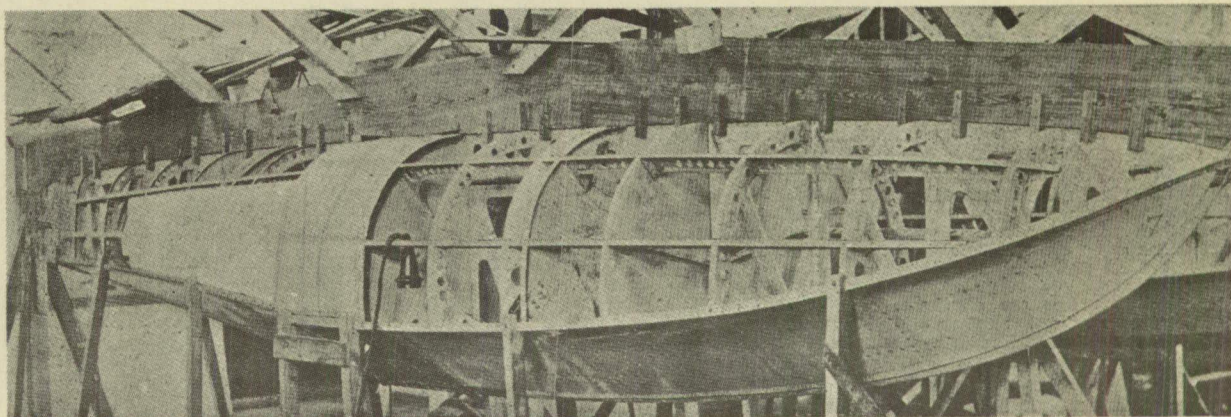


Fig. 7 One of the floats of the S.6.B on the stocks. The fuel tank is the section immediately in front of the step.

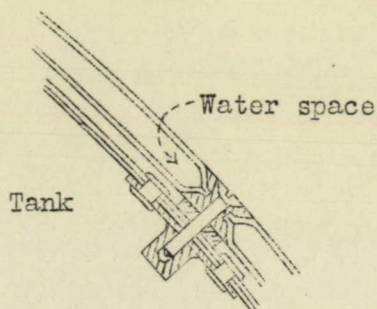


Fig. 8 Method of attaching the water radiator surface to the float.

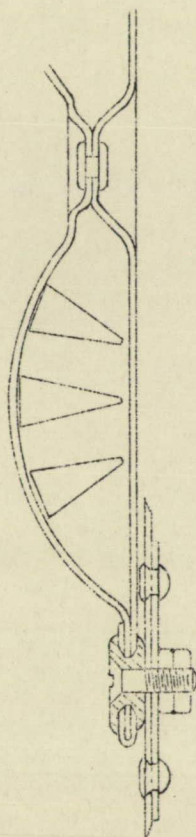


Fig.6 Section of a portion of one of the side oil coolers showing the copper-foil tongues soldered in the main channels to aid cooling, and the method of attachment of the cooler to the fuselage.